

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced GCE**

**CHEMISTRY**

Chains, Rings and Spectroscopy

**2814**

Wednesday

**18 JUNE 2003**

Afternoon

1 hour 30 minutes

Candidates answer on the question paper

Additional materials

*Data Sheet for Chemistry*

Scientific calculator

Candidate Name	Centre Number	Candidate Number										
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> </tr> </table>						<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> <td style="width: 20px; height: 20px;"></td> </tr> </table>					

**TIME** 1 hour 30 minutes

**INSTRUCTIONS TO CANDIDATES**

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	12	
2	12	
3	12	
4	8	
5	12	
6	10	
7	9	
8	10	
9	5	
<b>TOTAL</b>	<b>90</b>	

**This question paper consists of 15 printed pages and 1 blank page.**

Answer **all** the questions.

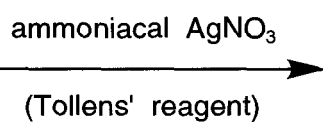
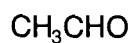
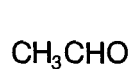
- 1 (a) (i) Name the compound  $\text{CH}_3\text{CHO}$ .

.....[1]

- (ii) Name the functional group of  $\text{CH}_3\text{CHO}$ .

.....[1]

- (iii) Draw structural formulae for the **organic** products of the reactions below.



[2]

- (b) (i) Describe what is meant by *nucleophilic addition*. Use the mechanism of the reaction of  $\text{CH}_3\text{CHO}$  with  $\text{HCN}$  in the presence of  $\text{KCN}$  in your answer.

.....  
.....  
.....

[5]

- (ii) Explain why this reaction is not normally carried out in a school or college laboratory.

.....  
.....[1]

- (iii) Will the product consist of optical isomers or not? Explain your answer.

.....  
.....  
.....  
.....[2]

[Total: 12]

- 2 Compound **A**,  $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)_2$ , can be made by heating benzene with 2-chloropropane in the presence of a catalyst.

(a) (i) Draw the structural formula of 2-chloropropane.

[1]

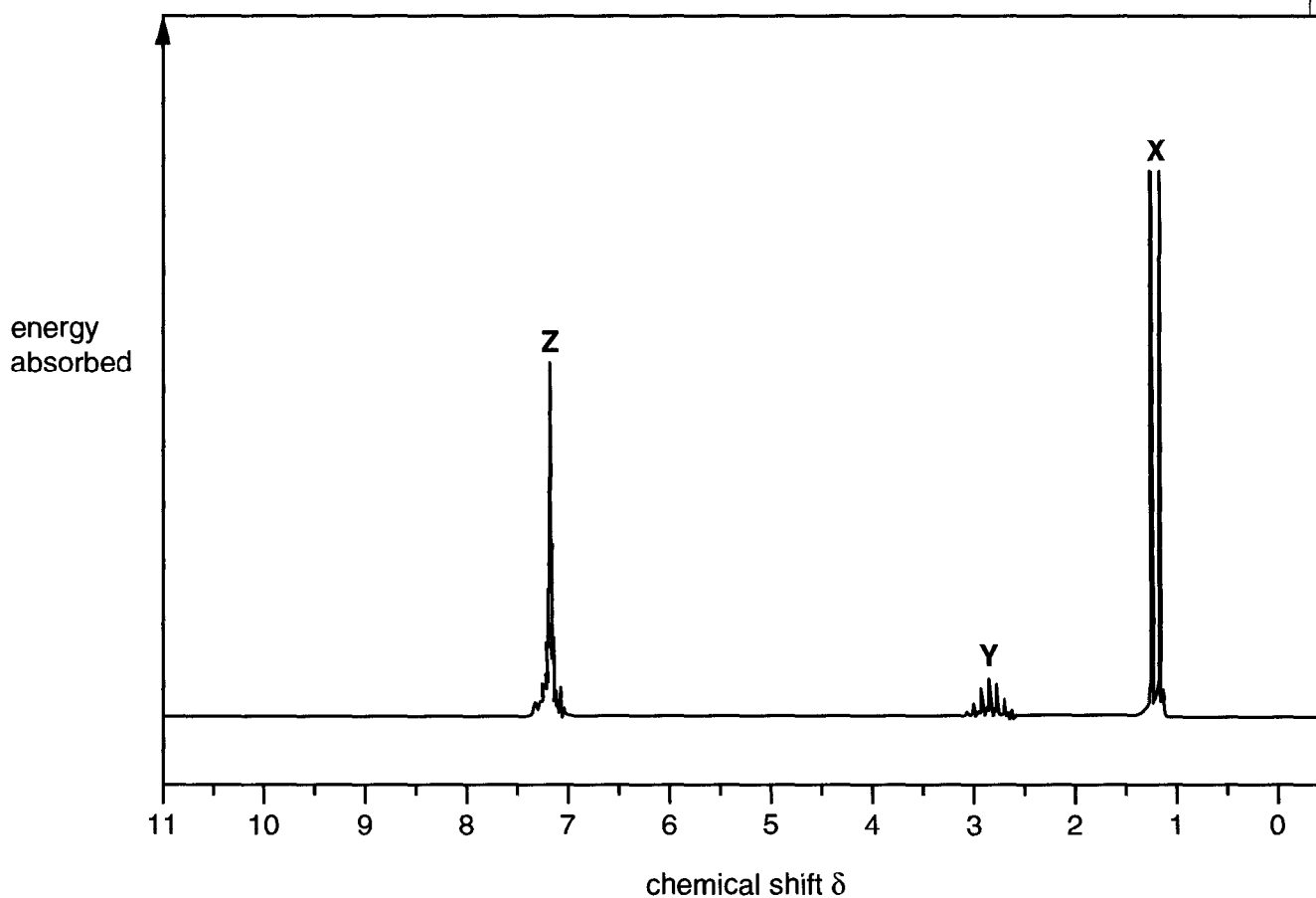
(ii) Write the equation for the synthesis of **A**.

[1]

(iii) Suggest the **type** of catalyst required.

[1]

(b) The n.m.r. spectrum of **A**,  $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)_2$ , is shown below.



- (i) Suggest the identity of the protons responsible for the groups of peaks **X**, **Y**, and **Z**. For each group of peaks, explain your reasoning in terms of the chemical shift value.

**X** .....

.....

**Y** .....

.....

**Z** .....

.....[6]

- (ii) Explain why peak **X** is split into a doublet.

.....

.....

..... [2]

- (iii) Suggest a reason why peak **Y** is split into many lines.

.....

.....

.....[1]

[Total: 12]

- 3** Analysis of some samples of soy sauce recently showed the presence of the potentially harmful chemical 3-chloropropane-1,2-diol.  
This could be formed from soya oil during the hydrolysis of soya.

**(a) (i)** Draw a displayed formula for 3-chloropropane-1,2-diol.

[2]

**(ii)** Does your displayed formula contain a chiral centre? Explain your answer.

.....  
.....[1]

**(b)** In this question, one mark is available for the quality of written communication.

Explain how **two** spectroscopic techniques could be used to confirm the presence of an OH group in an organic compound such as 3-chloropropane-1,2-diol or ethanol.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[5]

Quality of Written Communication [1]

- (c) Soya is a useful source of protein for vegetarians.  
Soya protein can be hydrolysed in the laboratory.

(i) State the reagent used.

.....[1]

(ii) Draw a displayed formula for the functional group which is hydrolysed in the protein.

[1]

(iii) State the class of organic compounds produced by hydrolysis of proteins.

.....[1]

[Total: 12]

**BLANK PAGE**



- 4 In aqueous solution, some organic compounds are bases and some are acids; others are neither.

- (a) Identify an organic compound that acts as an acid in water, and give an equation to show this behaviour.

name or formula .....

equation .....[2]

- (b) Phenylamine,  $\text{C}_6\text{H}_5\text{NH}_2$ , acts as a base in water.

- (i) Give an equation to show this behaviour.

.....[1]

- (ii) Explain why phenylamine is a weaker base than ethylamine,  $\text{C}_2\text{H}_5\text{NH}_2$ .

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[3]

- (c) Identify an organic compound which can act both as an acid and as a base. Explain your answer.

name or formula .....

explanation .....

.....  
.....  
.....[2]

[Total: 8]

- (a)** In this question, one mark is available for the quality of written communication.

[5]

**(b)** Phenylethene,  $\text{C}_6\text{H}_5\text{CH}=\text{CH}_2$ , reacts readily with bromine in an inert solvent. Benzene reacts with bromine only in the presence of a catalyst.

- [1]

- (ii) Explain why benzene reacts less readily than phenylethene with bromine.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

- (c) State **one** major use for phenylethene.

.....[1]

[Total: 12]

**(a)** Deduce the mass:charge ratio ( $m/e$ ) of the molecular ion in the mass spectrum of **B**.

.....[1]

**(b)** When **B**,  $\text{C}_4\text{H}_9\text{I}$ , is reacted with hot ethanolic sodium hydroxide,  $\text{HI}$  is eliminated and three isomeric alkenes **C**, **D** and **E** are formed. **C**, **D** and **E** form the same compound, **F**, when reacted with hydrogen in the presence of a palladium catalyst.

(i) Suggest structural formulae for **B**, **C**, **D**, **E** and **F**. Give your reasoning.

[8]

(ii) Classify the type of reaction in which **C**, **D** or **E** is converted into **F** using hydrogen and a palladium catalyst.

.....[1]

[Total: 10]

- 7 Diazonium salts are important reactive intermediates. They are made from aromatic amines, which themselves are usually made from aromatic nitro-compounds.

(a) (i) State the reagents required for the preparation of phenylamine from nitrobenzene.

.....[2]

(ii) A student obtained 6.80 g phenylamine starting from 10.0 g nitrobenzene. Calculate the percentage yield of phenylamine. Give your answer to three significant figures.

answer .....[4]

(b) State the reagents and conditions needed to make a diazonium salt from phenylamine.

reagents

.....

.....

conditions

.....[3]

[Total: 9]

- 8 There are two major types of polymerisation: addition polymerisation and condensation polymerisation.

(a) (i) Propene undergoes addition polymerisation.

Give a balanced equation for this polymerisation, using structural formulae.

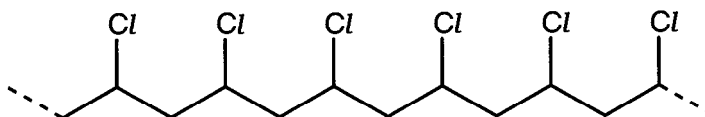
[2]

(ii) Explain the differences between **addition** polymerisation and **condensation** polymerisation.

.....  
.....  
.....  
.....  
.....[2]

(b) Polymer **G** is also formed by addition polymerisation.

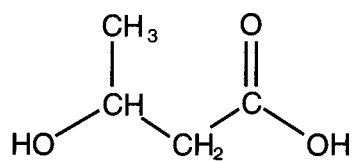
a section of  
polymer **G**



Deduce the structure of a monomer from which **G** could be made.

[1]

- (c) The monomer shown below can form a condensation polymer, **H**.



- (i) Suggest a structure for the polymer, showing **two** repeat units.

[2]

- (ii) Concentrated aqueous NaOH solution can be transported in containers made of poly(propene) but not in containers made of polymer **H**. Suggest reasons for this difference.

.....

.....

.....

.....

.....

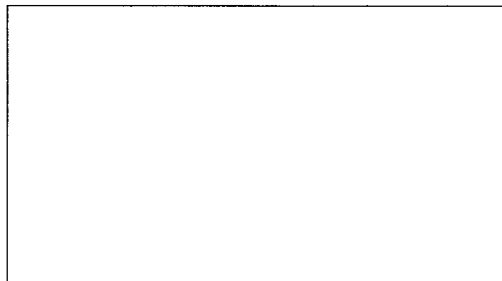
.....

.....[3]

[Total: 10]

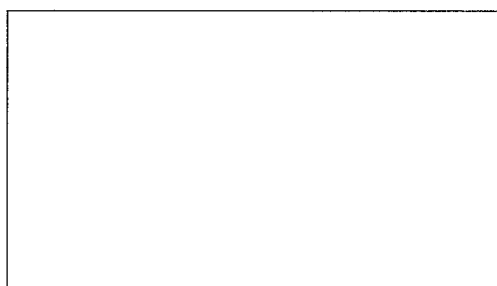
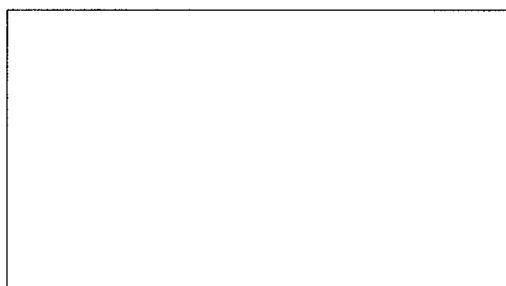
9 From the information given, draw the structural formula for each organic compound.

- (a) This compound is made by reaction of benzene with concentrated nitric acid in the presence of concentrated sulphuric acid.



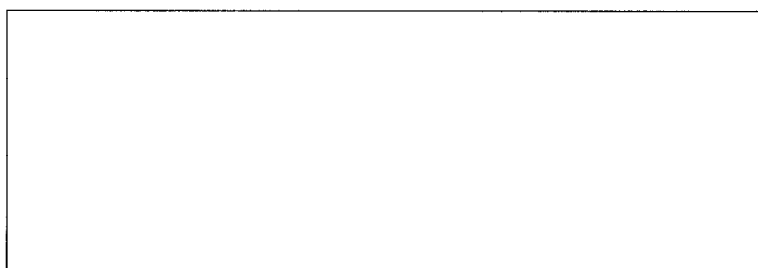
[1]

- (b) These two compounds react together in the presence of concentrated sulphuric acid to make methyl ethanoate,  $\text{CH}_3\text{COOCH}_3$ .



[2]

- (c) These two different compounds can be made by reaction of  $\text{C}_6\text{H}_5\text{CH}(\text{NH}_2)\text{COOH}$  with  $\text{CH}_3\text{CH}(\text{NH}_2)\text{COOH}$ .



[2]

[Total: 5]

---

Acknowledgement

SDBS Web [http://www.aist.go.jp/RIODB/SDBS/21\\_06\\_02](http://www.aist.go.jp/RIODB/SDBS/21_06_02)

OCR has made every effort to trace the copyright holders of items used in this Question paper, but if we have inadvertently overlooked any, we apologise